JUNE 28 - 30, 2005 NORFOLK CONVENTION CENTER

Mobile User Objective System (MUOS)

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Director of Operations

PEO Space Systems

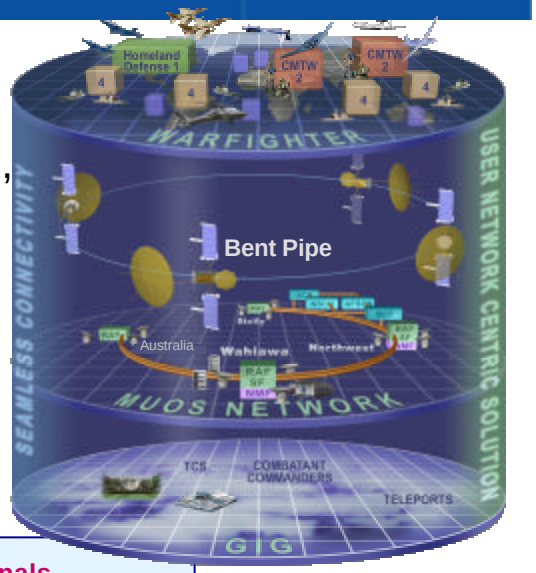
29 June 2005

Communications and Networking Session

Sponsored by
SPAWARSYSCOM
FORCEnet Chief Engineer

MUOS and FORCEnet

- MUOS is an "Edge" system in FORCEnet, providing the satellite narrowband (UHF) component of the Global Information Grid, accessing other GIG elements (e.g. TCA elements, DISN services, etc) via Teleports - MUOS will be the UHF SATCOM vehicle for FORCEnet, LANDWARNET, C2 Constellation, and the GIG
- MUOS will be the UHF SATCOM vehicle for Joint, Allied and Coalition operations
- MUOS is interdependent with Teleport and JTRS to deliver next generation UHF SATCOM capability



Circuits
Command and Control
Fire Support
Combat Operations
Search and Rescue
Tactical Data Links
Broadcast
Cruise Missile/UAV
Control/Data Links
Logistics

Tactical Circuit supporting joint and allied forces

Users
Navy
Marines
Army
Air Force
JTF
COCOMS
Gov't Agencies
Allies
Coalition Forces

Over 50 percent of SATCOM users are deployed via UHF

Terminals
AN/PSC-5 SPITFIRE
CSEL
URC-133 Federated
ARC-210
PRC-117F
WSC-3
Digital Modular Radio
Joint Tactical Radio System (JTRS)

More than 50 different types and over 18,000 terminals in-service today

"Narrowband satellite links are the only reliable means of communication for many tactical warfighters."

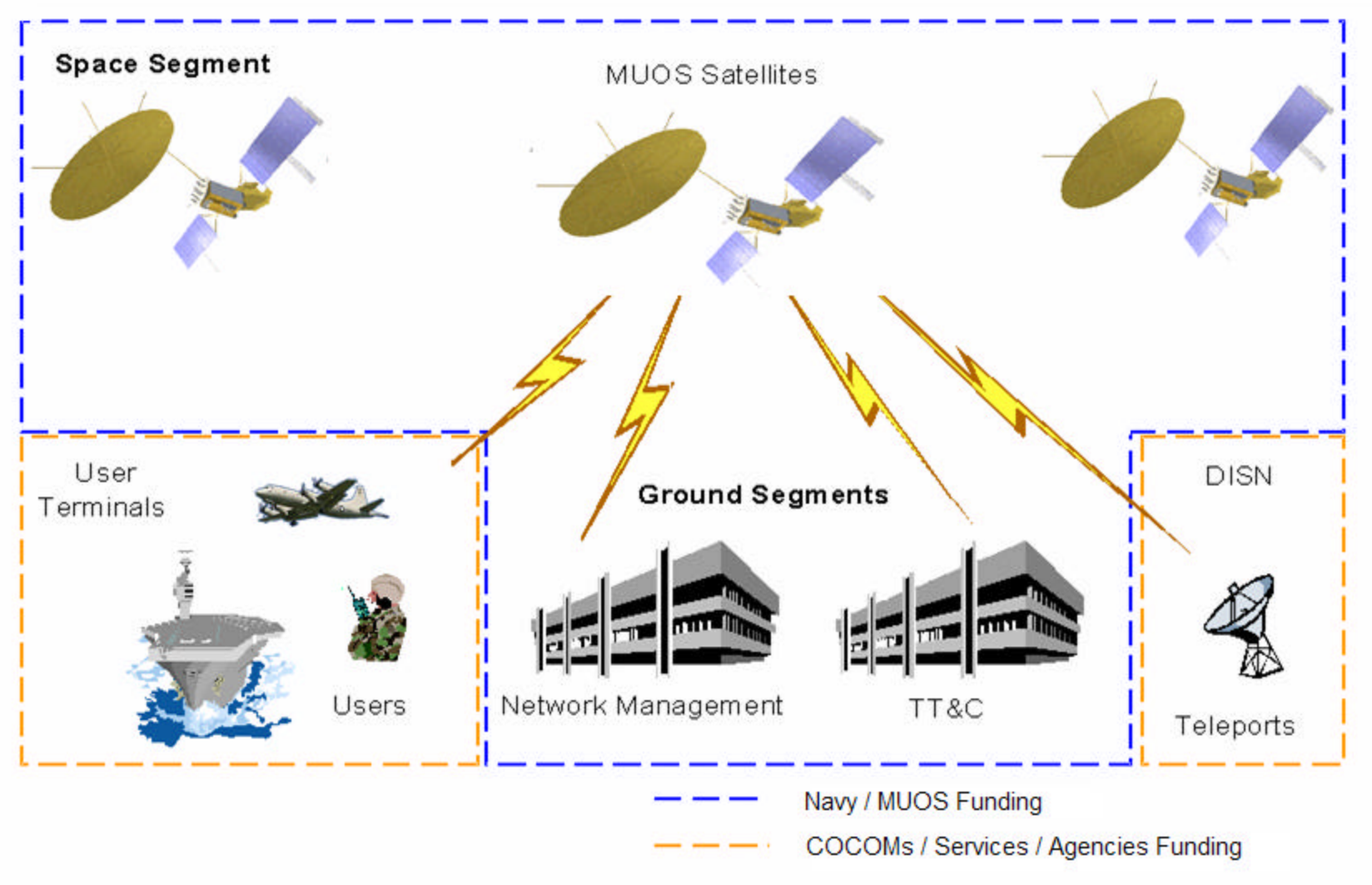
VADM H. A. Browne
USDEPCINCSPACE

SWarF 2000 Interim Report dtd 18 Jul 00

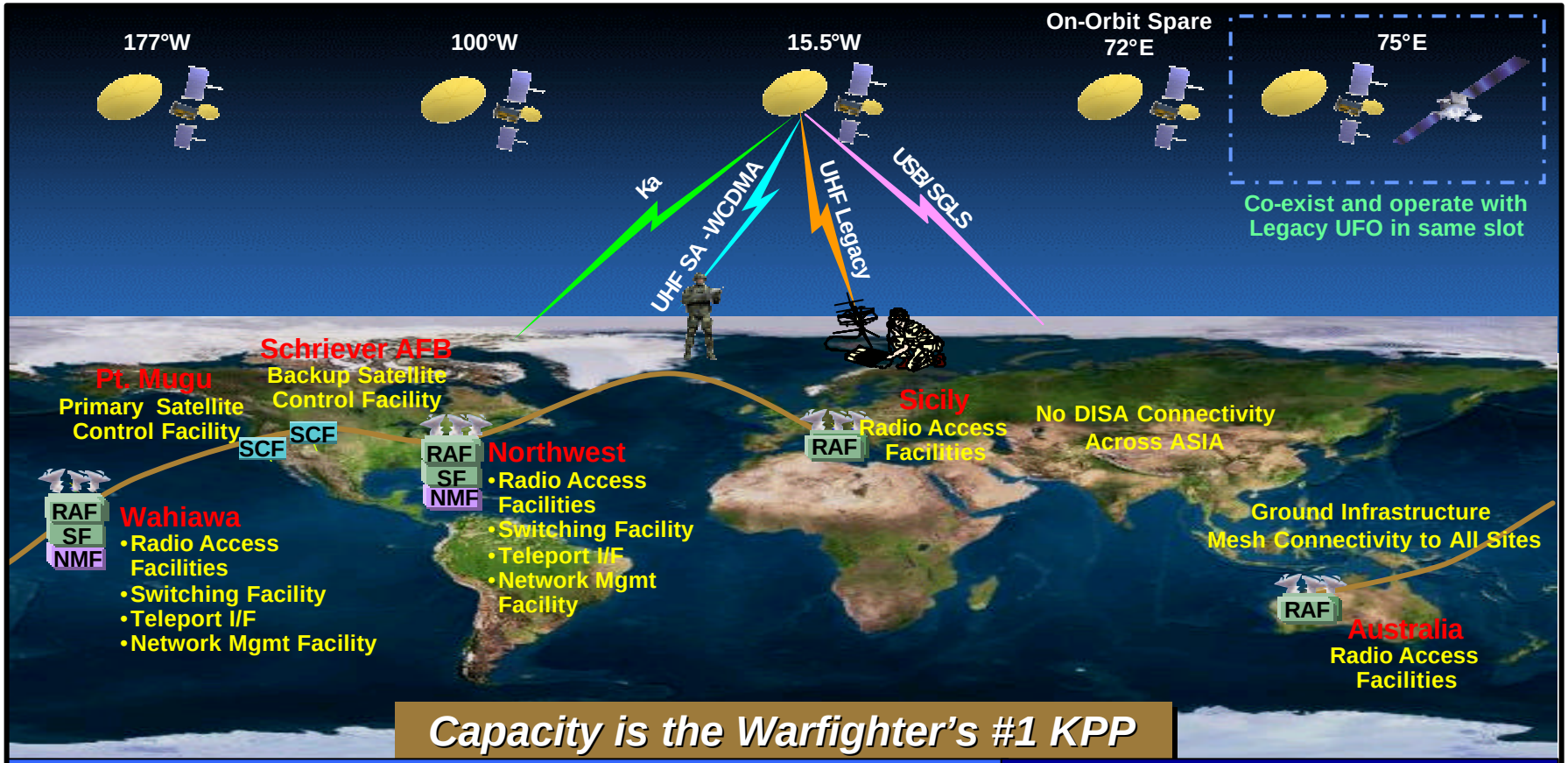
MUOS Overview

- Unprotected narrowband, 64 kbps and below
  - Five advanced satellites (4 active)
  - Integrated ground network
    - Manages the information network
    - Controls the satellites
    - Provides access to the GIG
  - Supports users in stressed RF environments
  - Inherent LPI/LPD/LPE and jam resistance
- Provides worldwide UHF SATCOM coverage
  - 16,332 simultaneous accesses with 40.216 Mbps total throughput worldwide
- Provides “Comms on the Move” for 21st century mobile forces

MUOS End-to-End System



Challenges and Gaps addressed



Capacity is the Warfighter's #1 KPP

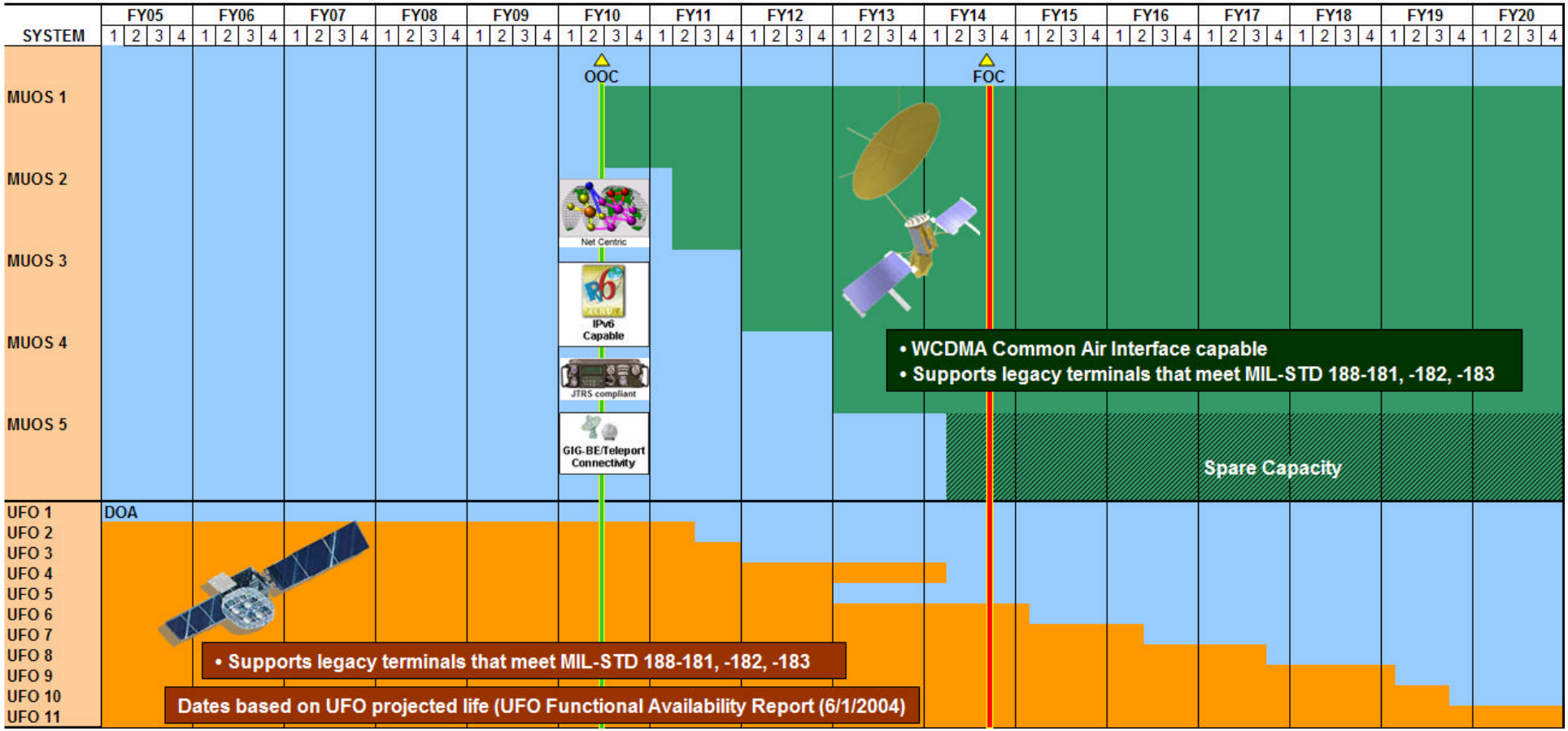
Legacy:	*1111 2.4kbps Accesses*	*2.666 Mbps*
MUOS:	*16,332 2.4kbps Accesses*	*40.216 Mbps*
	+ 424 2.4kbps Legacy Accesses	

Spectrally Adaptive (SA)-WCDMA enables high capacity in congested UHF spectrum

VOICE, VIDEO AND DATA SUPPORTING DISADVANTAGED TERMINALS IN ALL ENVIRONMENTS

MUOS Major Milestones

MUOS CAPABILITIES ROADMAP



MUOS Documentation

- *"Operational Requirements Document (ORD) for Joint Satellite Communications (SATCOM) Mobile User Objective System (MUOS),"* 23 September 2003
- Chairman of the Joint Chiefs of Staff Instruction 6250.01A, "*Satellite Communications*," 10 December 2001.
- "*Communications Service Requirements*," Commander Space and Naval Warfare Systems Command (PMW-146), 1 August 2003.
- Department of Defense Directive 4630.5, "*Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)*," 11 January 2002.
- Department of Defense Directive 8100.1, "*Global Information Grid (GIG) Overarching Policy*," 19 September 2002.
- "*End-to-End Information Assurance for the Global Information Grid*", DASD (C3, Space, and IT Programs) memorandum, 7 July 2003.
- "*Global Information Grid (GIG) Capstone Requirements Document*," U.S. Joint Forces Command, 21 August 2001.
- "*Joint Mobile User Objective System (MUOS) Concept of Operations*," U.S. Space Command, 5 November 2001.
- "*Joint Tactical Radio System (JTRS) Operational Requirement Document (ORD)*," 11 March 2003.
- "*Military Satellite Communications (MILSATCOM) System Threat Assessment Report*" (STAR), (NAIC-1574-0367-03- Chg1), July 2003.
- "*Operational Requirements Document for Department of Defense Teleport*," 31 July 2000.
- "*Satellite Communications (SATCOM) Systems Capstone Requirements Document (CRD)*," U.S. Strategic Command, 25 May 2003.

Backups

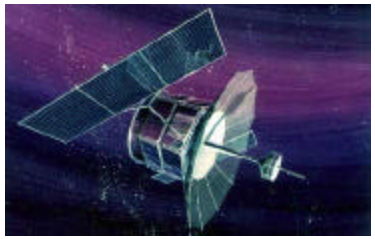
MUOS Acronym List

3G	Third Generation
AEHF	Advanced EHF
AoA	Analysis of Alternatives
AOS	Acquisition, Operations and Support
ADM	Acquisition Decision Memorandum
ASN(RDA)	Assistant Secretary of the Navy, Research, Development and Acquisition
B&O	Build and Operate
CAD	Component Advance Development
CAI	Common Air Interface
CAIG	Cost Analysis Improvement Group
CD	Complete Design
CAIV	Cost-as-an-Independent Variable
CDMA	Code Division Multiple Access
CDR	Critical Design Review
CE	Concept Exploration
CLIN	Contract Line Item Number
CMTW	Combined Major Theater of War
CNO N71	Chief of Naval Operations for Space, Information Warfare and Command and Control Director
CPIF	Cost Plus Incentive Fee
COMSEC	Communications Secuirty
CRD	Capstone Requirements Document
CSR	Communications Services Requirements
CY	Constant Year
DAMA	Demand Assigned Multiple Access
dB	decibels
DDR	Design Development Review
DISN	Defense Information Systems Network
DNRO	Director, National Reconnaissance Office
DoD	Department of Defense
DON	Department of the Navy
DPG	Defense Planning Guidance
DSAB	Defense Space Acquisition Board
DT	Developmental Test
DT&E	Developmental Test and Evaluation
EC	Earth Coverage
EELV	Evolved Expendable Launch Vehicle
EHF	Extremely High Frequency
EOA	Early Operational Assessment
ES	Evaluation Strategy
FFP	Firm Fixed Price
FOC	Final Operational Capability
FOT&E	Follow-on Test and Evaluation
FY	Fiscal Year
GBE	GIG Bandwidth Expansion
GIG	Global Information Grid
IER	Information Exchange Requirements
IOC	Initial Operational Capability
IP	Internet Protocol
IPA	Independent Program Assessment
IPR	In Process Review
JMINI	Joint MILSATCOM Integrated Network
JPEO	Joint Program Executive Office
JROC	Joint Requirements Oversight Council
JSAC	Joint SATCOM Acquisition Council
JTF	Joint Task Force
JTRS	Joint Tactical Radio System
kbps	kilo bits per second

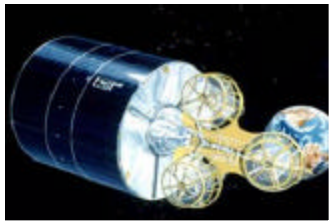
MUOS Acronym List (cont)

KDP	Key Decision Point
Khz	Kilo hertz
KPP	Key Performance Parameters
LEASAT	Navy's Leased Satellite System
LPD	Low Probability of Detection
LPE	Low Probability of Exploitation
LPI	Low Probability of Intercept
MAC	MUOS Acquisition Council
Mbps	Mega bits per second
MDA	Milestone Decision Authority
Mhz	Mega hertz
MILSATCOM	Military Satellite Communications
Mil-Stds	Military Standards
MNS	Mission Needs Statement
MRR	Mission Readiness Review
MS	Milestone
MSS	Mobile Subscriber Services
MUOS	Mobile User Objective System
NR KPP	Net-Ready Key Performance Parameter
NSSO	National Security Space Office
ORD	Operational Requirements Document
OT	Operational Test
OT&E	Operation Test and Evaluation
OTRR	Operational Test Readiness Review
PB	President's Budget
PD	Preliminary Design
PDR	Preliminary Design Review
PE	Program Element
PEO	Program Executive Office
PMW-146	Communications Satellite Program Office
PY	Prior Year
QOS	Quality of Service
RDT&E, N	Research, Development, Test, and Evaluation, Navy
RRDD	Risk Reduction and Design Development
SA	Spectrally Adaptive
SATCOM	Satellite Communication
SBA	Spot Beam Antenna
SCA	Software Communications Architecture
SCP	Satellite Control Processor
SDR	System Design Review
SPAWAR	Space and Naval Warfare Systems Command
SSFA	Space Systems Field Activity
SWarF	Senior Warfighter's Forum
TDMA	Time Division Multiple Access
TEMP	Test and Evaluation Master Plan
TRANSEC	Transmission Security
T-SAT	Transformational Satellite
TT&C	Telemetry, Tracking, and Commanding
TY	Then Year
UFO	UHF Follow-On
UHF	Ultra High Frequency
UMTS	Universal Mobile Telecommunications System
USecAF	Under Secretary of the Air Force
WCDMA	Wideband CDMA
WGS	Wideband Gapfiller System
WPN	Weapons Procurement, Navy

DoD Narrowband UHF Systems

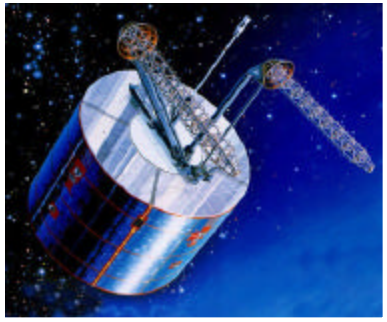


1978 - Present
FLTSATCOM

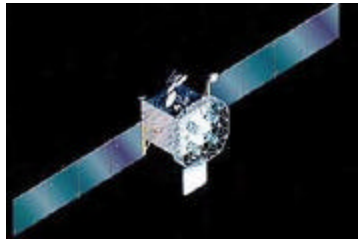


1976 - 1989
GAPFILLER / MARISAT
(Navy leased commercial)

1969 - 1972
TACSAT
(Early Navy Experimental)



1984 - Present
LEASAT
(Navy leased commercial)



1993 - Present
UHF Follow-on (UFO)

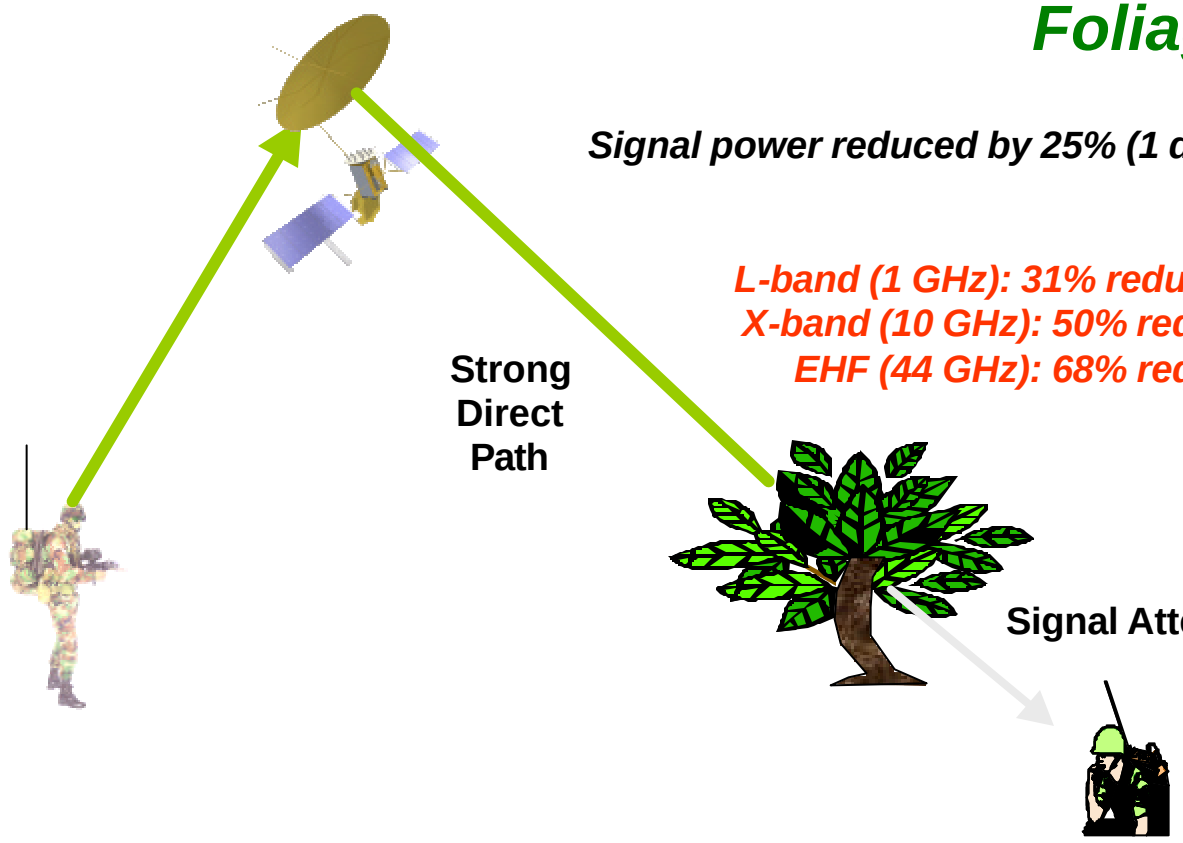
2010
MUOS

MUOS Overview

- Unprotected narrowband, 64 kilobits per second (kbps) and below, Military Satellite Communications (MILSATCOM) system
  - Network of five advanced satellites (4 active + 1 spare)
  - Ground equipment
    - Manage the information network
    - Control the satellites
    - Interface with other elements of the GIG
- Provides worldwide Ultra High Frequency (UHF) SATCOM
  - 16,332 simultaneous accesses with 40.216 Mbps throughput worldwide
- Replacement for today's oversubscribed UHF Follow-On (UFO) narrowband SATCOM constellation
- An "Edge" system in the TCA Government Reference Architecture (GRA), providing stand alone UHF capability that interfaces to Transformational Satellite (T-SAT) via the DoD Teleport
- Joint Service communications support to fixed-site and mobile users (including those in stressed environments):
  - - Encrypted voice/data
  - - Low data rate telemetry
  - - Remote computer access
  - - Imagery
  - - Short digital messages
  - - File transfer
  - - E-mail
  - - Remote sensor reception Paging
  - - Sporadic messaging for distributed applications
  - - Mixed voice and data communications services
  - - Internet
  - - Paging
  - - Facsimile

UHF Satellite Operational Issues (cont.)

Challenge: ***Mitigating severe signal degradations due to Foliage Attenuation***



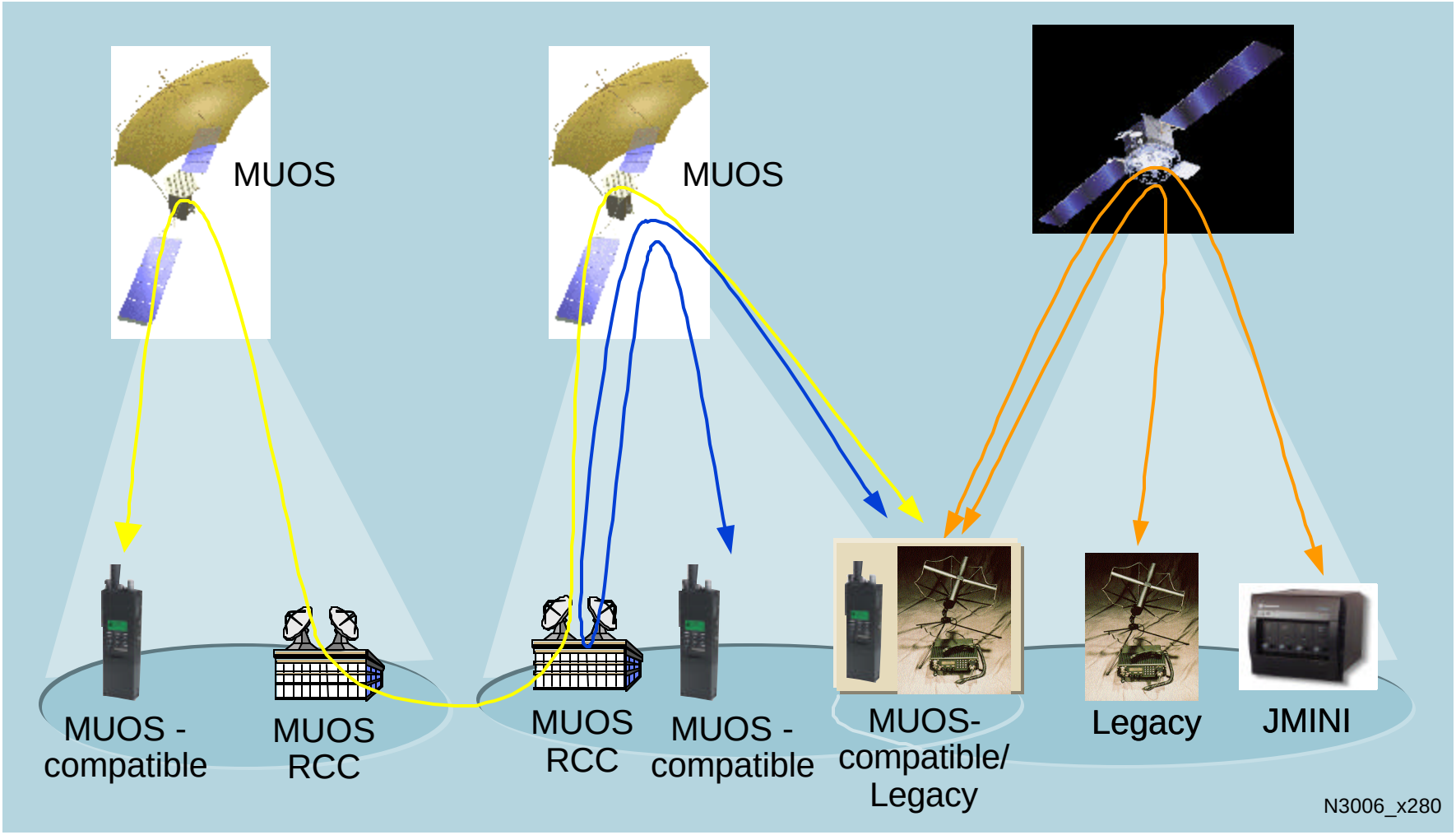
Signal power reduced by 25% (1 dB) at UHF (300 MHz) for each meter of foliage*

L-band (1 GHz): 31% reduction (1.6 dB) per meter
X-band (10 GHz): 50% reduction (3 dB) per meter
EHF (44 GHz): 68% reduction (5 dB) per meter

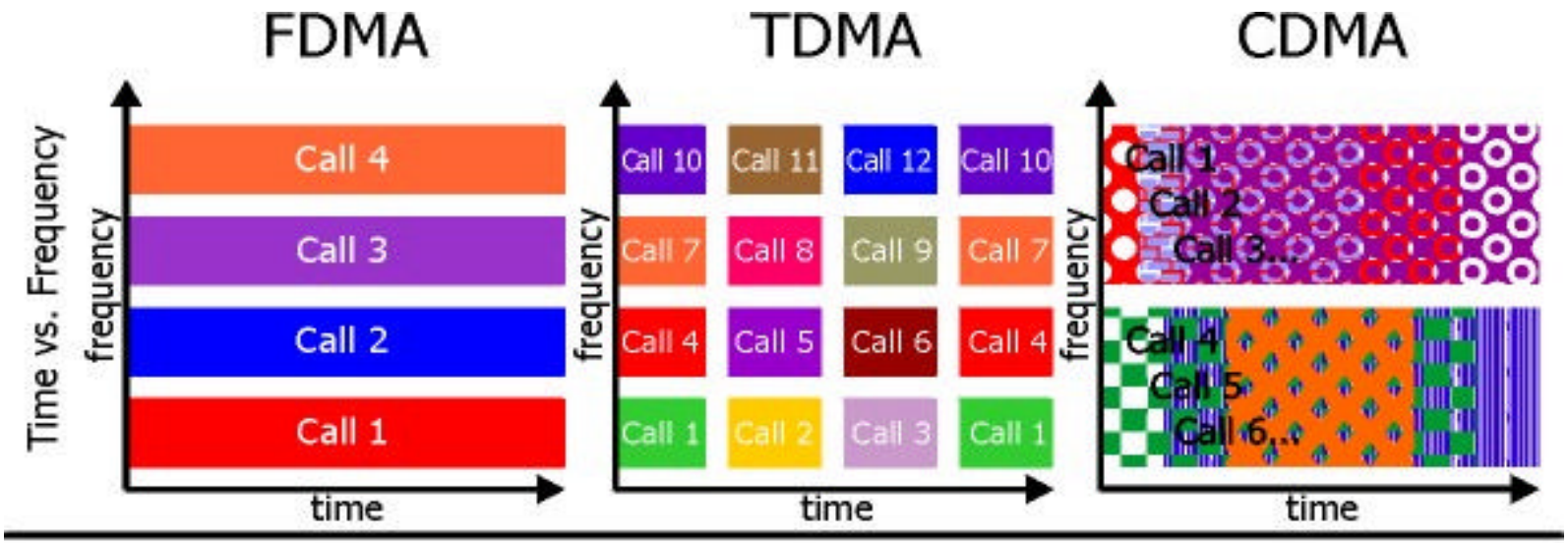
*** - FCC Bulletin No. 70, July 1997**

MUOS Approach: **Use UHF vs. higher frequency bands**

MUOS and Legacy Operations



Comparison



Conversation Analogy			
	Everyone talks in a different room to prevent interference. Since the conversation can't be heard from another room, it can be filtered from the other by going to the other room.	Within each room, everyone takes turns talking to prevent interference. Within each room, one person is talking at once, so they must talk fast to say everything.	Everyone speaks a different language at the same time in the same room. Since each language is unique, one may be filtered from another.

MUOS Frequencies

Satellite Receive and Transmit Frequencies